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First Underwater Artic Winter Expedition

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THE FIRST UNDERWATER ARCTIC WINTER EXPEDITION

Resolute Bay, Cornwallis Island,N.W.T. Canada

February 1971 - by Andres Pruna & Dr J. MacInnis

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Perhaps I should start off by stating the reasons for having an underwater expedition in the arctic. Recent human activities in the arctic have focused attention on mans poverty of knowledge in this area, morover there is a particular lack of understanding of ecosystem relationships within the Arctic Ocean. What we do know indicates that arctic marine biomass may be extremely "fragile" even to minor pollution stress. Complicating this situation is the fact that issues such as arctic progress, preservation and sovernity are gaining increasing national importance. The Canadian Government as well as other governments who posses territory in the arctic must consider immediately undertaking a comprehensive study of the biological aspects of these unique waters.

For decades scientists have endeavored to unravel the saline secrets of the Arctic Ocean. Almost invincible problems of hostile weather, ice, and water have restricted research to studies conducted from the surface of the sea. However, complete understanding of any environment cannot be gained by remote observations. Such knowledge can only

be won by repeated and long term studies within the environment itself.

In the past decade man has developed capabilities to dwell and work deep within the sea for prolonged periods. Underwater man now has the physiological adaptability and life supporting equipment and techniques to live 200 meters for multi day periods. As well, underwater man has demonstrated his ability to conduct meaningful scientific studies while living beneath the sea.

Fortunately some recent attention has been given to solving the problems of cold weather diving. Thus the free diving scientist is potentially able to conduct meaningful work within the Arctic Ocean.

It was with this background of ....

A. An increasing need to understand the Arctic Ocean environment,

B. A recognition that increased knowledge would result from studies within the Arctic Ocean,

C. A potential capability to place working scientist-divers in the Arctic Ocean .....

that this expedition was undertaken.

These words are really from " the First MacInnis Arctic Expedition " report. (ref. August 1970) This expedition took place in August 1970 and it's aim, as stated was to establish the first serious attempt in studying the underwater arctic an endeavor which until then had never taken place, at least in a consistent manner. When I state consistent I mean the fact that Dr. MacInnis who heads this very interesting program, wants ultimately to conduct it on a long term daily basis, using the same working area to accomplish a significent base line for arctic marine studies.

The first MacInnis Underwater Expedition discovered a great many problems and in a sense acted as "pathfinder" for the future winter expedition. As a result of this expedition, Dr. MacInnis and the other scientists with him proved that, not only was man capable of successfully working underwater in the Arctic Summer, but insured that the future expedition would be better prepared to cope with the winter environment.

The expedition was made possible by the generous contributions of "The National Geographic Society " who was also my sponsor, by assigning me to document the event for the "National Geographic Magazine."

General Electric Corporation, Ocean Systems, Pennsylvania donated some of its advanced closed circuit diving equipment to be tested in the extreme cold. In addition the "Towers Foundation, Joint Venture", which is in charge of the Resolute Bay Airport Facility was also involved.

The National Film Board of Canada, was in charge of producing a motion picture based on the expedition to be used in television. Other sponsors were :

U.S. Divers Company,

The Department of National Defense, Canadian

The Department of Indian Affairs and Northern Development

Imperial Oil Ltd.

Ocean Systems, Inc.

The Rolex Watch Company of Canada, Ltd.

University of Toronto Char Lake Project

Pains Wessex Canada Ltd (Unisuit)

Ontario Department of Lands and Forests

Real Eight Company

This expedition was sponsored by the MacInnis Foundation, a non-profit, research organization, established to study man and his environment .... with particular emphasis on the scientific and educational aspects of the marine environment.

SUMMARY

For six days between the 13th and the 18th of February 1971 two scientists, one diving equipment specialist and myself completed 35 dives through 5 foot of ice, averaging 6 hours per day in the Arctic Ocean near Resolute Bay in Canada's Northwest Territory.

In addition a crew of four cinematographers and one still photographer supported the photodocumentation aspects of the expedition. The diving was performed at an average depth of 40 feet and dive duration varied from several minutes to several hours. The objective of the dives were to gather information on the biological and human performance aspects of underwater arctic environment. The testing and evaluation of certain equipment not previously used in arctic conditions was also performed

A parallel objective was to clarify the problems of logistics and diving during winter in the Arctic. It is hoped that the results of this expedition will perhaps further implement some of the base line experiments that had already been performed during the previous summer expedition.

With the added information we obtained on the second arctic expedition we would be able to start some very basic conclusions as to what physiological requirements as well as equipment is necessary for an underwater all year round program in this area.

Since, to my knowledge, no previous winter condition arctic ocean diving has been performed we also had the opportunity to find out exactly what lies under the ice cap at this time of year and particularly compare the resulting observations to what had been found in the summer in the very same area.

Resolute Bay lies approximately 900 miles from the North Pole. The environmental conditions that we encountered at this time of year in this area were quite extreme . The

temperature fluctuated between minus 40 and minus 50 degrees farenheit during the period of time the expedition was taking place. No precipitation of any significence was observed, consequently we experienced what could be considered excellent weather. This in turn contributed to enabling us to accomplish most of the goals that we entertained for the expedition. These goals were as follows .....

A. Biological aspects, which entailed the collection and identification of the biological forms existing within our diving area.

B. The evaluation of equipment for future use in the arctic environment.

1. Closed Circuit Breathing Unit Mark 10 manufactured by General Electric Ocean Systems, Philadelphia .

2. The Subcom Communications System, diver to diver and diver to surface.

3. The Sublimus Sea Shell, Micro Habitat

C. Human Performance Aspect , by the use of the Bennet tool dexterity test and several other measuring

devices, an attempt was made to qualify the underwater performance by a diver in this area.

The Final Phase could be identified as the Photodocumentation phase and in this case the effort encompassed both cinematography and still photography.

No serious geological aspect was performed on this particular expedition. The results on the second arctic expedition are still a bit premature, however certain basic results were obvious immediately.

THE BIOLOGICAL PHASE

When we arrived in the Arctic our biologist in the group Mr. Larry Bell commenced to collect as many samples as possible in the short time available. These samples were to be identified and compared to those found in the summer. We did not really know whether most of the fauna would actually leave the area to deeper water or go into a state of hibernation for the duration of the winter. The collecting went well throughout the entire time and we were able to accumulate a considerable amount of speciments during the six day period. As a whole very little has as yet been determined about the biological aspect of the expedition, for the

identification is still going on. Some species of fish had apparently left the area and the flora seemed to be as extensive and active as it had been during the summer. Certain species were found that had not been found during the summer at least from first identifications. Whether this is due to some species coming in during winter conditions or due to the fact that the specie had simply not been captured during the summer expedition is not really known yet.

A great deal of activity was observed within the ice cap itself. Certain species, particularly the mysids seemed to live within or on the under part of the ice.

One of the possibilities that we considered prior to going to the arctic was that of ice crystals forming under the ice cap. These ice crystals had been experienced by a previous expedition to the Antarctic at McMurto Sound when observations of the ice environment of the Weddell Seal were made by Drs Ray and Lavallee. These crystals contributed to poor visibility as well as hiding the ice hole from the divers consequently a dangerous situation arose.

After we chopped a hole thru the ice which was approximately five feet in diameter we encountered no crystals other than some of the ice chips that were floating in the water as a result of our work. This was a pleasant surprise as the

hole turned up to be very visable when underwater and it also resulted in not interferring with the excellent visibility which made our photodocumentation quite successful. The underwater visibility was probably the best that I have ever encountered, comparing very much to what is found in the Florida Springs. We estimated it to be in the vicinity of 150 to 200 feet. The reason for this exceedingly good visibility was the fact that there was no wave action or precipitation with the ice cap containing the ocean in a virtually immobile state. In addition any fresh water flow from the land had been contained by the totally frozen environment. In this case, during the summer expedition, the outflow of the Mecham River,which drains an area estimated to be one hundred square miles produced a great deal of suspended matter within the bay, so consequently visibility during the summer was never more than 30 to 40 feet at best. Tidal fluctuations were observed but did not contribute to any perceivable currents.

The photography aspect of the expedition was unique in that a major effort was put forth to do as much as possible in this area. There were several reasons for this major effort. First, the generation of interest within Canada as well as in the States by having better documentation. Secondly, obvious importance of photodocumentation for scientific purposes.

Finally, the unusual environment presents a study in itself which can only be described with the aid of photography. For these reasons, the Canadian National Film Board with a film crew of four, which included cameraman, assistant cameraman sound man and director, took a complete set of underwater and topside cameras and all the other equipment thats part of major cine production and documented the entire expedition in 35 mm. This footage is to be used for a future one hour special to be shown on Canadian television.

National Geographic Magazine's photographer, James Sugar was sent to cover the topside aspects of the expedition on still photography while I was responsible for covering the underwater aspects in both medias. The photography turned out to be a revelation and I suppose, set many precedents that will serve as guidelines for future arctic winter photography underwater. Some of the problems encountered were quite unique. One example was in the area of film emulsion under thermal stress and the results were film shattering and breaking by mere touch. In addition high differential temperatures and high humidity in the working areas made condensation problems extremely acute to the point where changing the film or opening a camera, especially an underwater camera housing, was

impossible. The differential temperature is a point that should perhaps be elaborated on.

As our working area a shack had been constructed and placed over our diving site. The temperature outside the shack was approximately fifty degrees below zero and inside as high as ninty degrees above, so we are referring to a differential temperature of approximately 140 degrees between the outside and the inside of the shack. In addition, a thermocline inside the shack was also present. This thermocline was a result of poor insulation and the hole on the floor that served as our water entry consequently the temperature within the shack itself varied from the ceiling to the floor approximately 70 to 80 degrees. The humidity within the shack was never measured, but appeared to be --- extremely high, due to the continual extraction of equipment as well as divers from the water.

Over 10,000 feet of 35 mm motion picture film and more than 1,000 still pictures were shot on the surface and under water. The cameras in general functioned well and they included Nikon's and Leicas for still photography and Arriflex and Real Eight Ocean System Cameras for movies.

The films used were high speed Echtrachrome and Echtrachrome X for still cameras and for 35 mm motion picture the film used was 35 mm Eastman type 5254 negative film.

Finally, the physiological or human performance aspect was probably the most surprising in that we were able to dive for longer periods of time during the winter expedition than Dr. MacInnis had been able to perform during the summer expedition. The reasons for this can be attributed to the following factors, one we were better equipped than the expedition had been during the summer. We had the Mark Ten closed circuit diving apparatus; we used for the most part the Unisuit, a neoprene dry suit which is extremely effective for cold water diving; we had a shack which made our diving station quite comfortable. Another reason is that the individuals diving were for the most part, professionals. When we compare the divers comprising both expeditions we find that the four divers on the winter expedition were all seasoned divers, whereas during the summer expedition two of the divers were scientists and one of the divers was a complete novice.

The human performance aspect showed that shivering, which had been a consistent problem during the summer, was not encountered during the winter expedition hardly at all. We were able to

perform most of the dexterity tests with some amount of success. Perhaps some of the greatest problems we encountered were due to the lack of flexibility, as a result of the suits, gloves, etc. Two standard wet suit dives were performed during the expedition one of them by myself. After two hours I was drained of most of my resistance, consequently the next day,even though I dived with the warm Unisuit, I was still rather chilly. The water temperature was a constant 28.5 degrees farenheit, a great deal warmer than the surface temperature.

The performance of the equipment during this expedition was somewhat expected and, for the most part very encouraging. The standard open circuit scuba performed poorly as expected, most of the regulators, and there were several types, froze in a free flowing open position thereby consuming the air supply very rapidly and restricting the diver as far as his ability to perform other work. The Mark 10 closed circuit apparatus performed excellently and our longest dive which was a three hour dive was performed with this unit. No apparent breakdown of the baralime, the carbon dioxide scrubber, was observed and plenty of oxygen and diluent was left in the cylinder even after the long dive. The Swedish made Unisuit appears to have a definite advantage for extreme cold weather diving and certainly

holds a great deal of advantages when compared to other more complex heated suits. The primary advantage to this suit is the ease of donning and, of course, the ease of maintenance, but when referring to open or closed circuit hot water suits we also have the advantage of logistics and the nonexistance of contamination of the environment for biological studies. Both of these disadvantages are present with hot water suits.

Finally, the mini habitat, which was used primarily as a security station in the case of a diver out of air, proved to be not only an added safety factor, but also an extremely use-full tool for communication purposes.

The entire expedition was successful in that it completed most of the goals that it had set out to accomplish and also proved once and for all that man with modern diving equipment can live and work under the polar ice cap. Future plans are to take a habitat and place it in Resolute Bay so that a scientific team can monitor the environment on a daily basis. What we found on this expedition, as to the requirements needed to exist in this area, will be instrumental in furthering underwater man's capabilities in the Arctic. In addition we hope that our efforts may create a further interest in what may be termed as the last frontier left to man on our planet earth.

FIGURE #1

CANADIAN ARCTIC INCLUDING RESOLUTE BAY and the NORTH POLE

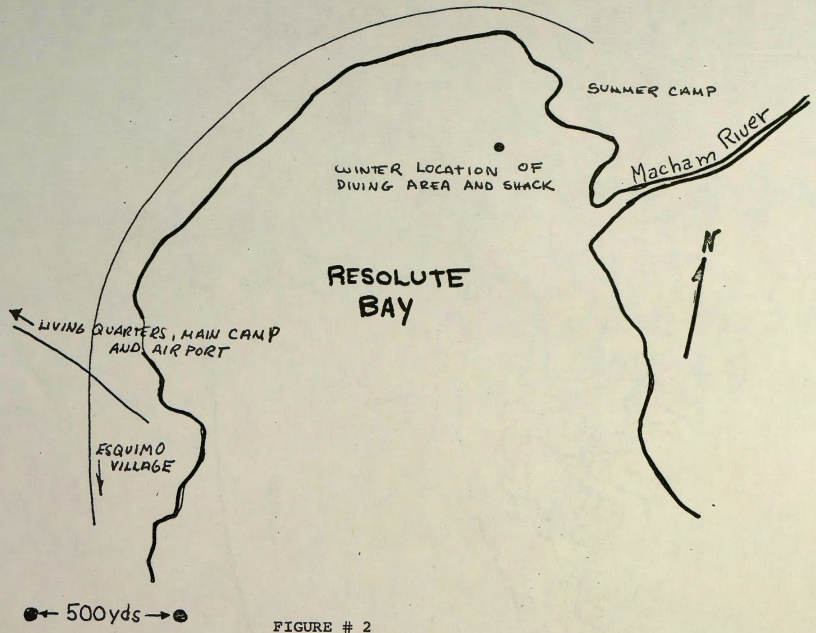

FIGURE # 2

APPROXIMATE LOCATION OF DIVING AREA
IN RESOLUTE BAY, FEBRUARY 1971

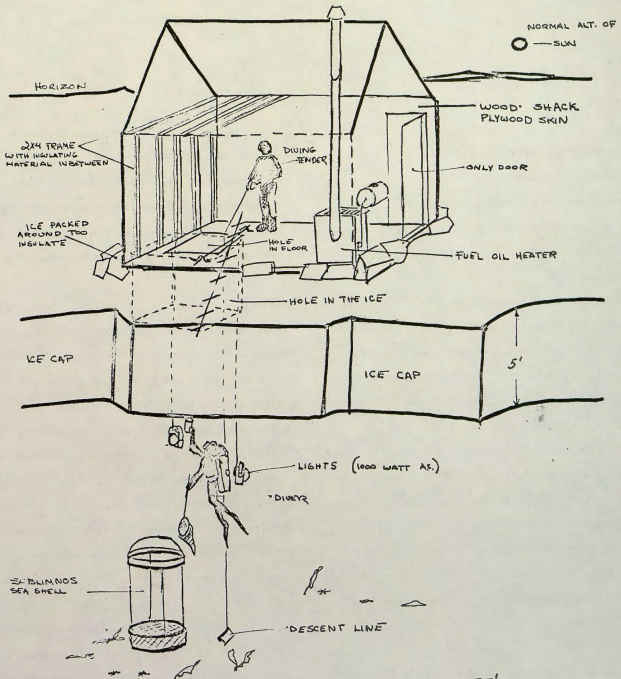

FIGURE # 3

Drawing showing shack and general description of working area.